

WHAT IS CLAIMED IS:

1. A makeup simulation program that causes a computer to perform a makeup simulation using a reference image comprising n (n is a positive integer) layer images and one facial image, the reference image having been generated previously according to a drawing instruction inputted by a user via a manipulation device, each of the n layer images containing at least one makeup element image in one color, the makeup simulation program being characterized by causing the computer to function as means as follows:

first image generation means for generating n first images corresponding to the respective n layer images on the basis of a transparency set in each pixel in each layer image for each of the n layer images;

target image acquisition means for acquiring a simulation target image containing a face of an individual as a simulation target;

mesh setting means for setting a mesh in a facial region contained in the reference image and setting a mesh in a facial region contained in the simulation target image;

deformation means for calculating a difference of positions between corresponding vertices of the meshes set in the reference image and in the simulation target image, and deforming the makeup element image contained in each of the n first images to fit in the facial region contained in the

simulation target image on the basis of the calculated difference;

second image generation means for generating n second images corresponding to the respective n layer images by performing a specific color conversion processing using color components of the n layer images on the simulation target image; and

synthesis means for determining transparencies of the respective n second images and the simulation target image on the basis of the n first images, and synthesizing the simulation target image and the n second images using the determined transparencies.

2. The makeup simulation program according to Claim 1, wherein:

the first image generation means generates the first images by generating transparency layer images on the basis of the transparency of each pixel set in the layer images and normalizing the transparency of each pixel in the generated transparency layer images; and

the synthesis means synthesizes the simulation target image and the second images by alpha blending.

3. The makeup simulation program according to Claim 2, wherein:

the second image generation means generates the second images by converting each of a color component of each layer image and respective color components of the simulation target image from an RGB color system to an HSV color system, performing the color conversion processing expressed by Equation (A) through Equation (C) below on both the converted color components, and converting resulting images from the HSV color system to the RGB system:

$$H_r = H_c \quad \dots \text{Equation (A)}$$

$$S_r = 0.8 \times S_f + 0.2 \times S_c \dots \text{Equation (B)}$$

$$V_r = 0.8 \times V_f + 0.2 \times V_c \dots \text{Equation (C)}$$

where H_c , S_c , and V_c represent an HSV value of the color component of layer image, S_f and V_f represent the HSV value of each pixel in the simulation target image, and H_r , S_r , and V_r represent the HSV value of each pixel in the second images.

4. The makeup simulation program according to any of Claims 1 through 3, wherein the mesh setting portion includes:

initial mesh storage means for storing an initial mesh in which all vertices comprise characteristic vertices set at characteristic positions of the face and other floating vertices;

reference position detection means for detecting a specific reference position from the facial region contained in each of the simulation target image and the reference image;

characteristic point extraction means for extracting characteristic points corresponding to the characteristic vertices from each of the simulation target image and the reference image on the basis of the reference position detected by the reference position detection means; and

vertex migration means for moving the characteristic vertices to the corresponding characteristic points extracted by the characteristic point extraction means, and moving the floating vertices while keeping distances among respective vertices of the initial mesh constant.

5. The makeup simulation program according to Claim 4, wherein:

the vertex migration means creates 3-D data for each vertex of the initial mesh by providing a height component orthogonal to an image plane, and moves the floating vertices by providing a certain height component to the floating vertices and positioning the characteristic vertices on the image plane while applying computations expressed by Equation (D) and Equation (E) below on each vertex a predetermined number of times:

(Mathematical Formula 1)

$$\vec{P}'_i = \vec{P}_i - \lambda (|\vec{P}_i - \vec{P}_j| - l_{ij})(\vec{P}_i - \vec{P}_j) \quad \cdots \text{EQUATION (D)}$$

$$\vec{P}'_j = \vec{P}_j + \lambda (|\vec{P}_i - \vec{P}_j| - l_{ij})(\vec{P}_i - \vec{P}_j) \quad \cdots \text{EQUATION (E)}$$

where a vector P_i represents a coordinate of the vertex of the mesh, a vector P_j represents a coordinate of the vertex of the mesh adjacent to the vector P_i , a vector P'_i represents the vector P_i to which the computations have been applied, a vector P'_j represents the vector P_j to which the computations have been applied, l_{ij} represents a length of a line segment linking the vector P_i and the vector P_j , and λ represents a constant value.

6. The makeup simulation program according to Claim 4, wherein the reference position detection means detects a position between eyebrows in each of the reference image and the simulation target image as the reference position, using a left eye segment image and a right eye segment image that form an eye region image comprising a region containing left and right eyes and the position between the eyebrows, and includes:

correlation value image generation means for generating a left eye correlation value image indicating a correlation of the left eye segment image with the face, and generating a right eye correlation value image indicating a correlation of the right eye segment image with the face;

correlation value image moving means for moving the left eye and right eye correlation value images on the basis of a relative positional relation of the left eye segment image and the right eye segment image with respect to the eye region image, so that a region indicating a high correlation within the left

eye correlation value image and a region indicating a high correlation within the right eye correlation value image overlap at the position between the eyebrows;

correlation value image superimposing means for superimposing the left eye and right eye correlation images that have been moved by the correlation value image moving means; and

position-between-eyebrows detection means for detecting the position between the eyebrows by detecting a region having a correlation value higher than a specific value in the left eye and right eye correlation value images superimposed by the correlation value image superimposing means.

7. The makeup simulation program according to Claim 6, wherein:

the correlation value image generation means generates the left eye and right eye correlation value images by applying a morphology processing on the facial image.

8. The makeup simulation program according to Claim 7, wherein:

the correlation value image generation means generates the left eye and right eye correlation value images by further applying a processing to reduce a resolution on the images to which the morphology processing has been applied.

9. The makeup simulation program according to Claim 6, wherein:

the correlation value image superimposing means superimposes the left eye and right eye correlation value images by multiplying corresponding pixel data of both the correlation value images moved by the correlation value image moving means.

10. The makeup simulation program according to Claim 9, wherein:

the correlation value image superimposing means superimposes the left eye and right eye correlation value images by applying a processing to enlarge a region having a high correlation on the left eye and right eye correlation value images moved by the correlation value image moving means.

11. The makeup simulation program according to Claim 10, wherein:

the correlation value image superimposing means performs a processing to further increase a correlation value in the region having the high correlation on the left eye and right eye correlation value images moved by the correlation value image moving means.

12. The makeup simulation program according to Claim 1, wherein:

the simulation target image is each frame image in a moving image.

13. A makeup simulation device that performs a makeup simulation using a reference image comprising n (n is a positive integer) layer images and one facial image, the reference image having been generated previously according to a drawing instruction inputted by a user via a manipulation device, each of the n layer images containing at least one makeup element image in one color, the makeup simulation device being characterized by including:

first image generation means for generating n first images corresponding to the respective n layer images on the basis of a transparency set in each pixel in each layer image for each of the n layer images;

target image acquisition means for acquiring a simulation target image containing a face of an individual as a simulation target;

mesh setting means for setting a mesh in a facial region contained in the reference image and setting a mesh in a facial region contained in the simulation target image;

deformation means for calculating a difference of positions between corresponding vertices of the meshes set in the reference image and in the simulation target image, and deforming the makeup element image contained in each of the n

first images to fit in the facial region contained in the simulation target image on the basis of the calculated difference;

second image generation means for generating n second images corresponding to the respective n layer images by performing a specific color conversion processing using color components of the n layer images on the simulation target image; and

synthesis means for determining transparencies of the respective n second images and the simulation target image on the basis of the n first images, and synthesizing the simulation target image and the n second images using the determined transparencies.

14. A makeup simulation method that causes a computer to perform a makeup simulation using a reference image comprising n (n is a positive integer) layer images and one facial image, the reference image having been generated previously according to a drawing instruction inputted by a user via a manipulation device, each of the n layer images containing at least one makeup element image in one color, the computer including first image generation means, target image acquisition means, mesh setting means, deformation means, second image generation means, and synthesis means, the makeup simulation method being characterized by including:

a step of generating n first images corresponding to the respective n layer images on the basis of a transparency set in each pixel in each layer image for each of the n layer images by the first image generation means;

a step of acquiring a simulation target image containing a face of an individual as a simulation target by the target image acquisition means;

a step of setting a mesh in a facial region contained in the reference image and setting a mesh in a facial region contained in the simulation target image by the mesh setting means;

a step of calculating a difference of positions between corresponding vertices of the meshes set in the reference image and in the simulation target image, and deforming the makeup element image contained in each of the n first images to fit in the facial region contained in the simulation target image on the basis of the calculated difference by the deformation means;

a step of generating n second images corresponding to the respective n layer images by performing a specific color conversion processing using color components of the n layer images on the simulation target image by the second image generation means; and

a step of determining transparencies of the respective n second images and the simulation target image on the basis of the n first images, and synthesizing the simulation target image

and the n second images using the determined transparencies by the synthesis means.